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COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

RE: Application Serial No.: 09/623,474
Applicants: Masamoto UENISHI et al
Filing Date: September 13, 2000
For: COMPOSITE HOLLOW FIBER MEMBRANE AND METHOD OF PRODUCING THE SAME
Group Art Unit: 1771
Examiner: Victor CHANG

SIR:

Attached hereto for filing are the following papers:

PTO COVER LETTER
APPEAL BRIEF W/ATTACHED APPENDIX (IN TRIPLICATE)

Our credit card payment form in the amount of $330.00 is attached covering any required fees. In the event any variance exists between the amount enclosed and the Patent Office charges for filing the above-noted documents, including any fees required under 37 C.F.R 1.136 for any necessary Extension of Time to make the filing of the attached documents timely, please charge or credit the difference to our Deposit Account No. 15-0030. Further, if these papers are not considered timely filed, then a petition is hereby made under 37 C.F.R. 1.136 for the necessary extension of time. A duplicate copy of this sheet is enclosed.

Respectfully submitted,

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF	:
Masamoto UENISHI et al	: GROUP ART UNIT: 1771
SERIAL NO.: 09/623,474	: EXAMINER: Victor CHANG
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APPEAL BRIEF

COMMISSIONER FOR PATENTS
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Appellants appeal the final rejection of Claims 1, 3-8 and 11-17 of the above-identified application as set forth in the Official Action dated April 4, 2003.

I. REAL PARTY IN INTEREST

The real party in interest is Mitsubishi Rayon, Co., Ltd. by virtue of the assignment executed on September 5, 2000. The executed assignment was recorded in the U.S. Patent & Trademark Office on November 6, 2000, beginning at Reel 011271, Frame 0816.

II. RELATED APPEALS AND INTERFERENCES

To the best of Appellants' undersigned representative's knowledge, there are no related appeals or interferences.

III. STATUS OF CLAIMS

Claims 1 and 3-17 are pending in the above-identified application. Claims 1, 3-8 and 11-17 are appealed. Claims 9-10 are withdrawn from consideration due to a Restriction Requirement.

IV. STATUS OF AMENDMENTS

An amendment to Claim 1 was submitted in a response to the final rejection mailed April 4, 2003, which was filed on July 7, 2003 and was entered by the Examiner in an Advisory Action mailed August 7, 2003.

V. SUMMARY OF INVENTION

The present invention relates to a hollow fiber membrane that can be used for the treatment of water, as in home water purifiers and industrial water filtration modules and for the treatment of air, as in dust filters. The composite hollow fiber membrane of the present invention is made by stacking three or more layers of membrane that have a 3-dimensional net structure which has a plurality of micropores formed from stacked lamella and microfibrils connected with a stacked lamella, and has one or more dense layer(s), the dense layer(s) being thinner than an outermost layer and an innermost layer with the dense layer(s) comprising micropores of a mean pore diameter smaller than that of the micropores of the outermost layer and the innermost layer, as an intermediate layer disposed between the outermost layer and the innermost layer. The claimed composite hollow fiber membrane has an overall porosity of not less than 75% by volume. The isothermal crystallization time τs of the resins of the outermost layer and the innermost layer and the isothermal crystallization time τp of the resin of the dense layer are required to satisfy the following relationship: $1 < \tau p/\tau s < 100$. See the specification at page 1, first full paragraph and page 6, lines 7-23.

VI. ISSUES

The issues in this appeal are as follows: whether or not Claims 1, 3-8 and 11-17 are unpatentable under 35 U.S.C. § 103(a) over EP 0740952 A1 either individually, or in view of JP 3-169330 (Abstract).

The rejections under 35 U.S.C. § 112, first and second paragraphs were withdrawn in a paper mailed August 19, 2003.

VII. GROUPING OF CLAIMS

Claims 1, 3-7 and 11-17 stand or fall together. The patentability of claim 8 will be argued in a separate paragraph below.

VII. ARGUMENTS AGAINST THE REJECTION OF CLAIMS 1, 3-7 AND 11-17 UNDER 35 U.S.C. §103

Claim 1 contains a limitation on the overall porosity of the composite hollow fiber membrane of not less than 75% by volume. The advantages of having the overall porosity of the composite hollow fiber membrane of not less than 75% by volume are discussed on page 20, lines 4-8 of the specification and indicate that the filtration life of the composite hollow fiber membrane is extended by making the porosity 75% by volume or higher.

EP 0740952 A1 does not describe a composite hollow fiber membrane having three or more layers of membrane, which has an overall porosity of not less than 75% by volume.

The Examiner refers to Table 1, page 13 of EP 0740952 A1, as showing a porosity overlapping with the overall porosity of Claim 1 and ranging from 64 to 76% porosity in Examples 1-10. However, it can be seen from a reading of the examples of EP 0740952 A1 that Examples 1, 2 and 4-10 are directed to two-layer hollow fiber membranes and only

Example 3 is directed to a three-layer hollow fiber membrane potentially analogous to that of present Claim 1. Further, the three layer hollow fiber membrane of Example 3 of EP 0740952 A1 has a porosity of only 64%, which is in fact the lowest porosity disclosed in the table and is far lower than the "overall porosity of not less than 75% by volume" of present Claim 1. Therefore, there is no teaching or suggestion in EP 0740952 A1 to motivate the worker of ordinary skill in the art arrive at a composite hollow fiber membrane which has three or more layers and an overall porosity of not less than 75% by volume, as set forth in present Claim 1.

Further, Claim 1 contains a limitation on the isothermal crystallization time τs of the resins used for the outermost layer and the innermost layer and the isothermal crystallization time τp of the resin used for the dense layer satisfying the relationship: $1 < \tau p/\tau s < 100$. The relationship between the isothermal crystallization time of the resins used for the outermost layer and the innermost layer and the isothermal crystallization time of the resin used for the intermediate dense layer, when satisfied, as in amended Claim 1, produces a composite hollow fiber membrane which shows significant improvement in water permeability and separation accuracy, as described on page 25, last line through page 26, line 23 of the specification. Further, the above description in the specification indicates that if the ratio exceeds 100, orientation of the resins in the direction of the thickness of the membrane is disturbed, resulting in a non-uniform distribution of micropore sizes after stretching and unsatisfactory performance of the composite hollow fiber membrane. There is no description in EP 0740952 A1 of any isothermal crystallization time for any of the resins used in the hollow fiber membrane of EP 0740952 A1, much less a ratio between the isothermal crystallization time of the resins used for the outermost layer and the innermost layer and the isothermal crystallization time of the resin used for the intermediate dense layer, as in present

Claim 1. Therefore, there is no motivation to the worker of ordinary skill in the art from EP 0740952 A1 to arrive at the ratio of present Claim 1.

The Examiner argues that the ratio of the isothermal crystallization time of the resins used for the outermost layer and the innermost layer and the isothermal crystallization time of the resin used for the intermediate dense layer is either an inherent physical property of the polyolefins selected for the membrane manufacturing process, which process is superficially similar to the process of producing the composite hollow fiber membrane of present Claim 1, or an obvious optimization to one of ordinary skill in the art. However, since the ratio depends on both the particular resins used in the layers of the hollow fiber membrane and the manufacturing process of making the composite hollow fiber membrane, and EP 0740952 A1 neither teaches nor suggests any isothermal crystallization time for any of the resins used in the hollow fiber membrane of the reference, there is no motivation to the worker of ordinary skill in the art to arrive at a composite hollow fiber membrane having the ratio of present Claim 1. The Examiner's interpretation of the teachings of EP 0740952 A1 is an impermissible hindsight reconstruction of the prior art in light of Applicants' disclosure.

JP 3-169330 does not remedy the deficiencies of the European patent, because the weight ratio described in the Abstract of the Japanese patent refers only to one layer (B) as having a void ratio of 30-90% and does not refer to the overall porosity of a composite hollow fiber membrane of the Japanese reference as being not less than 75% by volume, as recited in present Claim 1. Further, the Abstract of JP 3-169330 neither teaches nor suggests any isothermal crystallization time for any resin used to form the hollow fiber membrane of the Japanese patent, much less disclosing the ratio of isothermal crystallization times of the resins of the layers, as in present Claim 1. The claims distinguish over the combination of references.

Finally, to support further the contention that the present claims distinguish over the combination of references, comparative data in the specification in which Examples 1-5 of the present invention, having overall porosities within the range of present Claim 1 and being three-layer composite fiber membranes, demonstrate superior results, when compared to Comparative Examples 1 and 2, which are two-layer composite hollow fiber membranes and have overall porosities outside the range of present Claim 1, but at 73.0 and 73.5%, are very close to the upper limit of porosity of 76% shown in Table 1 on page 13 of EP 0740952 A1. The three layer composite hollow fiber membranes of Examples 1-5, according to present Claim 1, show superior results in water permeation amounts, which range from 35.5 to 38.6 $L/(m^2hrKPa)$, as compared to 33.4 and 32.1 for Comparative Examples 1 and 2, respectively. Also, in a continuous water permeation test set forth on pages 43 and 44 of the specification, which is displayed under the heading "Accumulated Amount of Water Permeated Through Continuous Water Permeation Test", superior results are shown for Examples 1-5, according to present Claim 1, ranging from 65.0 to 90.6 $L/(m^2KPa)$, as compared to 60.2 and 22.5 for Comparative Examples 1 and 2, respectively. It is clear that the superior results demonstrated for three-layer composite hollow fiber membranes having an overall porosity of not less than 75% by volume, according to present Claim 1 distinguish the present claims over composite hollow fiber membranes of EP 0740952 A1.

The Examiner dismisses the above comparative data by stating that, while the results demonstrate the superior performance of a three-layer composite hollow fiber membrane over a two-layer composite hollow fiber membrane, the comparison is irrelevant to the three-layer composite hollow fiber membrane based on the teaching of the prior art combination. However, since EP 0740952 A1 does not set forth an overall porosity range for hollow fiber membranes anywhere in the specification and only shows porosity %s in Table 1 and the only

three-layer composite hollow fiber membrane shown in Table 1 is Example 3, which has a porosity of only 64%, well below the "overall porosity of not less than 75% by volume" of present Claim 1, it is submitted that the above comparative data is pertinent, because the porosities of Comparative Examples 1 and 2 of the specification are much higher than the porosity of the only three-layer composite hollow fiber membrane of Table 1 and very close to the upper limits of the porosity % of 76% for the remaining examples of Table 1.

ARGUMENT AGAINST THE REJECTION OF CLAIM 8 UNDER 35 U.S.C. § 103

In addition to the arguments set forth for the patentability of Claim 1 in the paragraph above, Claim 8 sets forth a specific initial water permeation amount that is neither disclosed nor suggested by either cited reference as a property of the membrane of the claimed invention.

In view of the preceding arguments Appellants respectfully request that the Examiners' rejections of Claims 1, 3-8 and 11-17 be reversed.

Respectfully submitted,

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APPENDIX

Pending claims on appeal in U.S. Application 09/623,474

1. A composite hollow fiber membrane comprising three or more layers of membrane comprising a three-dimensional net structure comprising a plurality of micropores comprising stacked lamella and micro fibrils connected with the stacked lamella, wherein

one or more dense layer(s), said dense layer(s) being thinner than an outermost layer and an innermost layer and said dense layer(s) comprising micropores of a mean pore diameter smaller than that of the micropores of the outermost layer and the innermost layer, is disposed as intermediate layer(s), between the outermost layer and the innermost layer, wherein the composite hollow fiber membrane has overall porosity of not less than 75% by volume, and wherein

the isothermal crystallization time τs of the resin used for the outermost layer and the innermost layer and the isothermal crystallization time τp of the resin used for the dense layer satisfy the following relationship:

$1 < \tau/\tau s < 100$.

3. The membrane according to Claim 1, wherein the outermost layer and the innermost layer have a mean microfibril length in a range from 0.5 to 10 μm and mean distance between microfibrils in a range from 0.1 to 0.6 μm.

4. The membrane according to Claim 1, wherein the dense layer has a mean microfibril length in a range from 0.2 to 5 μm and a mean distance between microfibrils in a range from 0.02 to 0.3 μm.

5. The membrane according to Claim 1, wherein each of the outermost layer and the innermost layer has a thickness in a range from 5 to 50 μm.

6. The membrane according to Claim 1, wherein the dense layer has a thickness in a range from 3 to 15 μm.

7. The membrane according to Claim 1, further comprising a cover layer of a hydrophilic polymer.

8. The membrane according to Claim 1, wherein the initial water permeation amount is 25.0 L/(m2 hr kPa) or higher.

11. The membrane according to Claim 7, wherein the microfibrils are divided into groups of a plurality of pieces that are bundled together and said plurality of micropores are elliptic.

12. The membrane according to Claim 1, comprising a cover layer of a hydrophilic polymer and wherein the microfibrils comprise bundled groups of microfibrils.

13. The membrane of Claim 1, wherein said layers comprise thermoplastic resin(s).

14. The membrane of Claim 11, wherein said resin(s) are polyamide(s) or polyolefin(s).

15. The membrane of Claim 12, wherein said polyolefin(s) are isotactic polypropylene, poly-4-methyl-1-pentene, poly-e-methylbutene-1 and polyvinylidene fluoride and mixtures thereof.

16. The membrane of Claim 1, wherein the inner diameter is in a range from 50 to 5000 μm.

17. The membrane of Claim 1, wherein the total thickness is in a range of from 30 to 200 μm.

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one or more dense layer(s), said dense layer(s) being thinner than an outermost layer and an innermost layer and said dense layer(s) comprising micropores of a mean pore diameter smaller than that of the micropores of the outermost layer and the innermost layer, is disposed as intermediate layer(s), between the outermost layer and the innermost layer, wherein the composite hollow fiber membrane has overall porosity of not less than 75% by volume, and wherein

the isothermal crystallization time τs of the resin used for the outermost layer and the innermost layer and the isothermal crystallization time τp of the resin used for the dense layer satisfy the following relationship:

$1 < \tau/\tau s < 100$.

3. The membrane according to Claim 1, wherein the outermost layer and the innermost layer have a mean microfibril length in a range from 0.5 to 10 μm and mean distance between microfibrils in a range from 0.1 to 0.6 μm.

4. The membrane according to Claim 1, wherein the dense layer has a mean microfibril length in a range from 0.2 to 5 μm and a mean distance between microfibrils in a range from 0.02 to 0.3 μm.

5. The membrane according to Claim 1, wherein each of the outermost layer and the innermost layer has a thickness in a range from 5 to 50 μm.

6. The membrane according to Claim 1, wherein the dense layer has a thickness in a range from 3 to 15 μm.

7. The membrane according to Claim 1, further comprising a cover layer of a hydrophilic polymer.

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15. The membrane of Claim 12, wherein said polyolefin(s) are isotactic polypropylene, poly-4-methyl-1-pentene, poly-e-methylbutene-1 and polyvinylidene fluoride and mixtures thereof.

16. The membrane of Claim 1, wherein the inner diameter is in a range from 50 to 5000 μm.

17. The membrane of Claim 1, wherein the total thickness is in a range of from 30 to 200 μm.